Mesoscale patterns in barnacle reproduction are mediated by upwelling-driven thermal variability

Table S1. Sampling dates at each location. Missing samplings are marked with X.

Dates	L0 - Cariño	L1 - A Coruña	L2 - Camelle	L3 - Bueu	L4 - Cangas	L5 - Baiona	L6 - A Guarda
2017_July	x	26-07-2017	x	x	27-07-2017	28-07-2017	x
2017_August	x	25-08-2017	x	28-08-2017	22-08-2017	23-08-2017	x
2017_September	x	20-09-2017	x	20-09-2017	23-09-2017	19-09-2017	19-09-2017
2017_October	x	06-10-2017	09-10-2017	09-10-2017	05-10-2017	09-10-2017	09-10-2017
2017_November	x	04-11-2017	07-11-2017	06-11-2017	07-11-2017	03-11-2017	03-11-2017
2017_December	x	05-12-2017	04-12-2017	18-12-2017	04-12-2017	03-12-2017	03-12-2017
2018_January	x	x	05-01-2018	16-01-2018	x	31-01-2018	31-01-2018
2018_February	x	27-02-2018	02-02-2018	12-02-2018	01-02-2018	27-02-2018	27-02-2018
2018_March	x	04-03-2018	05-03-2018	20-03-2018	x	x	x
2018_April	x	x	02-04-2018	25-04-2018	x	x	x
2018_May	x	14-05-2018	14-05-2018	15-05-2018	15-05-2018	17-05-2018	17-05-2018
2018_June	x	15-06-2018	13-06-2018	25-06-2018	14-06-2018	13-06-2018	13-06-2018
2018_July	x	24-07-2018	17-07-2018	23-07-2018	16-07-2018	12-07-2018	17-07-2018
2018_August	x	14-08-2018	14-08-2018	x	13-08-2018	12-08-2018	12-08-2018
2018_September	12-09-2018	12-09-2018	12-09-2018	11-09-2018	11-09-2018	10-09-2018	10-09-2018
2018_October	08-10-2018	26-10-2018	09-10-2018	22-10-2018	25-10-2018	06-10-2018	06-10-2018
2018_November	x	x	23-11-2018	x	x	x	x
2018_December	05-12-2018	11-12-2018	x	10-12-2018	07-12-2018	06-12-2018	06-12-2018
2019_January	08-01-2019	07-01-2019	08-01-2019	24-01-2019	10-01-2019	08-01-2019	08-01-2019
2019_February	20-02-2019	x	05-02-2019	19-02-2019	20-02-2019	19-02-2019	19-02-2019
2019_March	20-03-2019	20-03-2019	20-03-2019	x	22-03-2019	21-03-2019	21-03-2019
2019_April	17-04-2019	19-04-2019	22-04-2019	30-04-2019	22-04-2019	18-04-2019	18-04-2019
2019_May	20-05-2019	22-05-2019	21-05-2019	15-05-2019	19-05-2019	18-05-2019	18-05-2019
2019_June	x	17-06-2019	x	17-06-2019	20-06-2019	14-06-2019	14-06-2019
2019_July	08-07-2019	05-07-2019	03-07-2019	30-07-2019	04-07-2019	01-07-2019	03-07-2019
2019_August	02-08-2019	29-08-2019	01-08-2019	29-08-2019	02-08-2019	01-08-2019	01-08-2019
2019_September	03-09-2019	30-09-2019	30-09-2019	18-09-2019	03-09-2019	30-09-2019	30-09-2019

Text S1. Number of broods estimation

The number of broods per individual per year was estimated following a modified version of the method proposed by Hilgard (1960), whose equation is:

$$N = \sum_{i=1}^{n} A\,(D \cdot T) \qquad (1)$$

Where N is the number of broods per individual per year, A is the monthly average proportion of adults with eggs (all samplings from the same month was averaged for each location), D is the number of days of each month (28, 30 or 31 days depending on the month), and T is the length of the embryo development in days considered as the time from oviposition to release.

The original method by Hilgard (1960) calculates the number of broods based on intervals between sampling dates. Nevertheless, our field sampling program has some heterogeneity between locations due to different starting dates and sampling gaps forced by bad weather conditions. These prevented us to have a full year to compare the number of brood in the 7 locations. To solve this, we calculated an annual reproductive pattern for each location using all data available (from July 2017 to September 2019) in which an average (± SE) of the percentage of individuals with eggs was calculated for each month in all locations (Fig. 3 of the ms). In order to get the annual number of broods by region and a measure of its dispersion, the average and the upper (+SE) and lower (-SE) levels were summed along the months

Previous works on *P. pollicipes* (e.g. Molares et al. 1994b, Cruz & Araujo 1999, Macho 2006) used a fixed embryo development time of 25 days based on a laboratory experiment done at 20°C (Molares et al. 1994a). Nevertheless, it is known that embryo development time in barnacles greatly depends on seawater temperature (longer times at lower temperatures) as it has been found in *Austrominius modestus, Chthamalus montagui* and *Perforatus perforatus* (Patel & Crisp 1960), three species commonly found in Galicia. Moreover, seawater temperature of 20°C is usually warmer than mean temperatures found in Galicia during the *P. pollicipes* reproductive period (Fig. 2a of the ms). Based on this it is expected that the number of broods for *P. pollicipes* have been overestimated in all previous works since the duration of the embryo development is most of the times longer than those 25 days used.

Patel & Crisp (1960) in a laboratory experiment found that *Chthamalus stellatus agg.* (*C. montagui* as later clarifyed by Burrows et al. 1992) takes 7, 9, 14, 17 and 30 days at 29, 24, 18, 15 and 9°C respectively to complete its embryo development. In the case of *Perforatus perforatus* takes 4, 5, 7, 9 and 20 days at 27, 20, 17, 15 and 10°C respectively, similar to *Austrominius modestus*; 6, 8, 9, 18, 42 and 60 days at 25, 18, 15, 9, 6 and 3°C respectively. We fit these data to several models (power law fit, exponential, logarithmic, and linear) and found that the power law fit ($y = a \cdot x^b$) achieved the highest goodness of fit in the three barnacles species, because is the one better capturing the large increase in the duration of embryo development at low temperatures (Figure 1, Table 1). The exponential and logarithmic models also gave quite a good fit, nevertheless, both suffer to fit the observed data at low temperatures, while the linear model was the worst. High coefficients of determination (r^2) were found using the potential model: 0.99 for *C. montagui* and 0.97 for *P. perforatus* and *A. modestus* (Table 1). We therefore used this model to estimate embryo development time for *P. pollicipes* at different temperatures. In order to reconstruct a potential model for *P. pollicipes* we used as *b constant* for the model the average of the *b constants* between the three other barnacles; -1.369. The model was also forced to pass by the xy point already known (25 days at 20°C) by adjusting manually the *a constant*; 1525. Since the model was reconstructed based just on one point a r^2 of 1 was of course obtained. Doing so we obtained embryo development times for *P. pollicipes* of 51, 41, 34, 29 and 25 days at 12, 14, 16 18 and 20°C respectively.

We are aware of the inherent issues on the model reconstruction we have made. Nevertheless, we still consider that assuming a fixed embryo development time of 25 days for all temperatures has issues as well, since it goes against the observed effect of temperature in the length of the embryonic development observed in many barnacles. And what it is worst, this way a relevant overestimation of the number of broods and the reproductive capacity of this commercial species is done, which can be risky in terms of fisheries management. There is a trade off, but using the reconstructed model for estimating the effect of temperature on the embryo development time of *P. pollicipes* is a precautionary approach in terms of fisheries management that also aligns with the temperature effect on the reproductive ecology of barnacles. A fixed embryo development time is neither precautionary nor aligned with reproductive barnacle ecology.

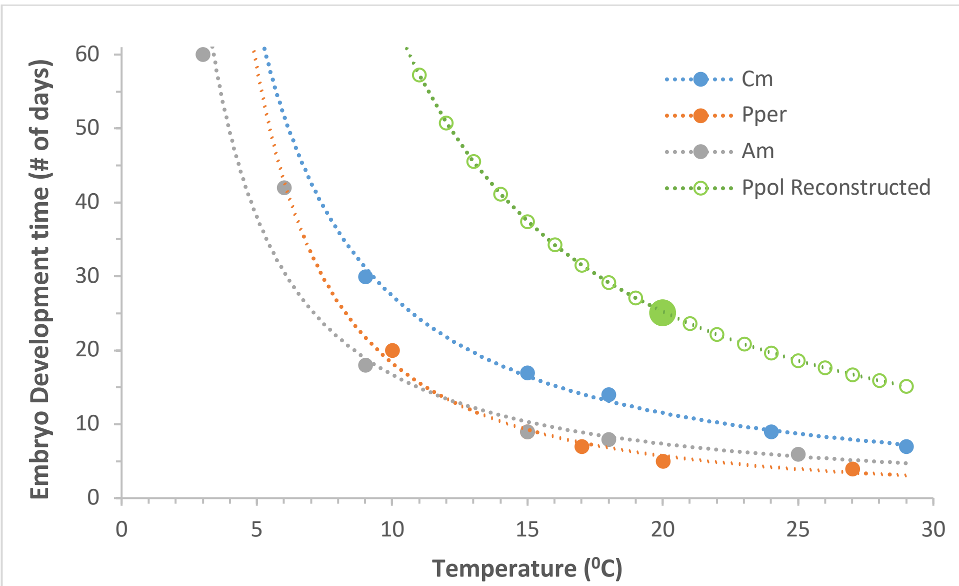

Figure S1. Barnacle embryo development relationship with temperature. A potential model (dotted lines) was fitted to observed data (dots) from a lab experiment for *C. montagui* (Cm), *P. perforatus* (Pper) and *A. modestus* (Am) (Patel & Crisp 1960). A reconstructed model for *P. pollicipes* (Ppol) was obtained based on the previous models and the data point (25 days at 20°C: large green dot) from Molares et al. (1994a).

Table S2. Models (potential, exponential, logarithmic, and linear) and coefficients of determination between temperature and embryo development time for the four barnacles. Models were fitted to data from a lab experiment for *C. montagui* (Cm), *P. perforatus* (Pper) and *A. modestus* (Am) (Patel & Crisp 1960). Since the potential model achieved the best goodness of fit, this model was afterwards used to estimate the relationship between temperature and embryo development time for *P. pollicipes* (Ppol) based on the only observed data point available (25 days at 20°C: large green dot), from Molares et al. (1994a).

Species	**Potential model** ($y = a \cdot x^b$)		**Exponential** (r^2)	**Logarithmic** (r^2)	**Linear** (r^2)
	Equation	r^2			
C. montagui	$y = 484.61 \cdot x^{-1.248}$	0.994	0.987	0.978	0.895
P. perforatus	$y = 861.61 \cdot x^{-1.674}$	0.966	0.883	0.868	0.733
A. modestus	$y = 256.04 \cdot x^{-1.185}$	0.967	0.899	0.931	0.749
P. pollicipes	$y = 1525 \cdot x^{-1,369}$	1	-	-	-

PERIODOGRAMS FOR SST AND UI FOR EACH LOCATION

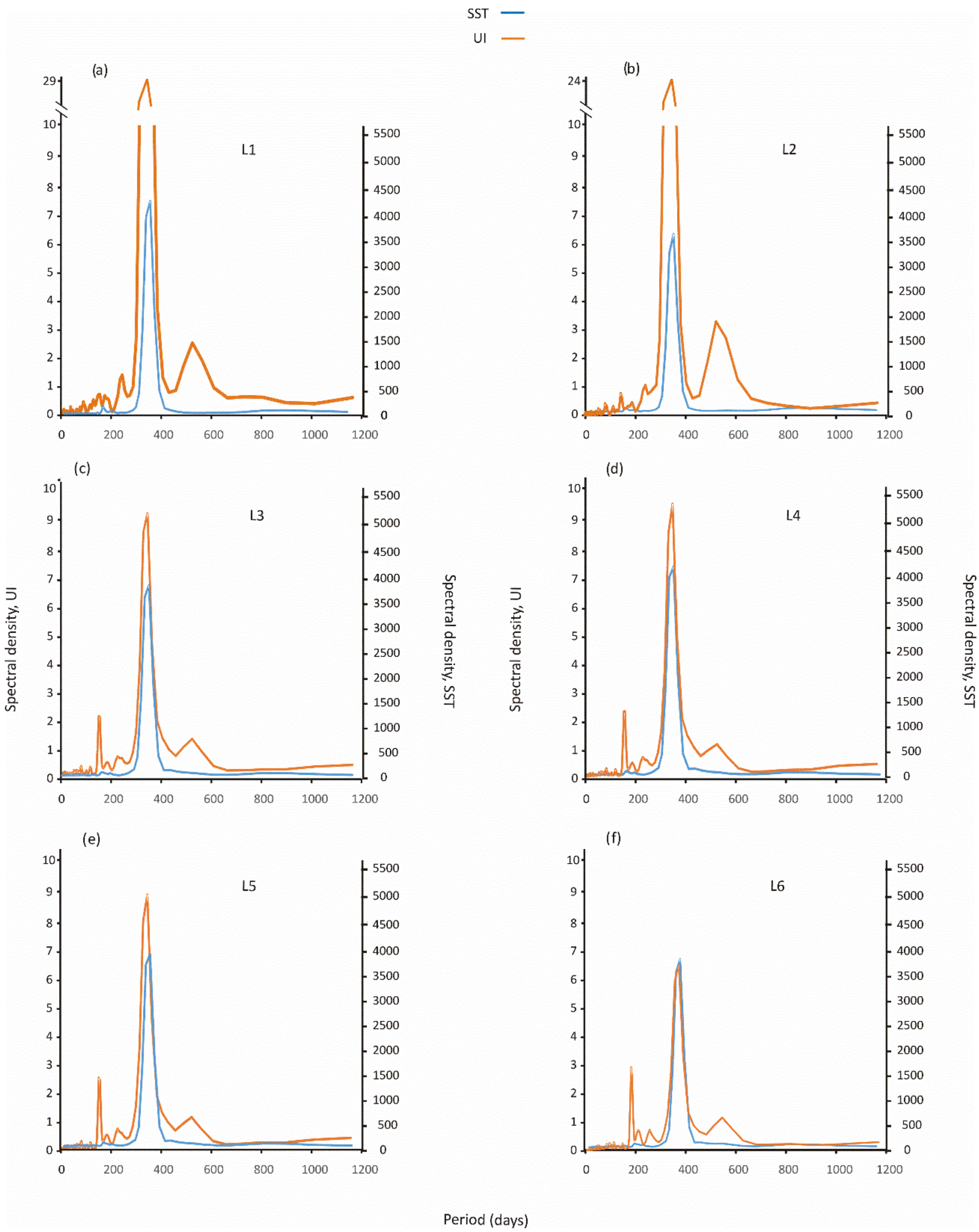

Figure S2. Periodograms of SST and UI for each of the sampling locations. In panels (a) and (b), the vertical axis for UI is split at a spectral density value of 10.

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